What is claimed is:

1. A method of tracking moving objects in time-series pictures with processing the pictures, each picture being divided into blocks, each block consisting of a plurality of pixels, wherein in a case where an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the method comprising the step of:

(a) assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value, thereby allowing different identification codes to be assigned to different moving objects overlapping in a picture.

2. The method according to claim 1, wherein the processing of the step (a) is performed for each of N ($N \geq 2$) consecutive pictures within the time-series pictures, the method further comprising the step of:

(b) judging whether or not: a first object consisting of a group of blocks assigned a first identification code and a second object consisting of a group of blocks assigned a second identification code are in contact with each other in each of the N consecutive pictures; and a correlation

between the first objects in every temporally adjacent pictures in the N consecutive pictures is more than a predetermined value.

3. The method according to claim 2, wherein the correlation is approximately equal to a ratio of an area of a logical AND between a figure obtained by moving one of the temporally adjacent first figures on the basis of a motion vector thereof and the other of the temporally adjacent first figures to an area of the one or the other of the temporally adjacent first figures.

4. The method according to selective claim 2 or 3, further comprising the step of:

(c) tracking the first and second objects backward in time after the judgment of the step (b) is positive.

5. An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program; and

a processor coupled to the storage device,

wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is

divided into blocks, each block consisting of a plurality of pixels, an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the program comprising the step of:

(a) assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value, thereby allowing different identification codes to be assigned to different moving objects overlapping in a picture.

6. The apparatus according to claim 5, wherein the program further comprising the steps of:

performing the processing of the step (a) for each of N ($N \geq 2$) consecutive pictures within the time-series pictures; and

(b) judging whether or not: a first object consisting of a group of blocks assigned a first identification code and a second object consisting of a group of blocks assigned a second identification code are in contact with each other in each of the N consecutive pictures; and a correlation between the first objects in every temporally adjacent pictures in the N consecutive pictures is more than a predetermined value.

7. The apparatus according to claim 6, wherein the correlation of the step (b) is approximately equal to a ratio of an area of a logical AND between a figure obtained by moving one of the temporally adjacent first figures on the basis of a motion vector thereof and the other of the temporally adjacent first figures to an area of the one or the other of the temporally adjacent first figures.

8. The apparatus according to any one of claim 6 or 7, the program further comprising the step of:

(c) tracking the first and second objects backward in time after the judgment of the step (b) is positive.

9. A method of tracking moving objects in time-series pictures with processing the pictures, each picture being divided into blocks, each block consisting of a plurality of pixels, wherein an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the method comprising the steps of, when a first block whose motion vector is not determined is present,:

(a) picking up determined motion vectors of blocks surrounding the first block;

(b) classifying the determined motion vectors into

groups such that an absolute value of a difference between any two motion vectors in the same group is less than a predetermined value; and

(c) estimating a motion vector of the first block to be approximately equal to an average of motion vectors belonging to one, having the largest number of motion vectors, of the classified groups.

10. The method according to claim 9, wherein when there is no determined motion vector to be picked up at the step (a), the motion vectors estimated at the step (c) are regarded as determined motion vectors, and then the steps (a) to (c) are performed.

11. An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program; and

a processor coupled to the storage device,

wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of pixels, an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is

determined in a unit of block, the program comprising the step of, when a first block whose motion vector is not determined is present,:

(a) picking up determined motion vectors of blocks surrounding the first block;

(b) classifying the determined motion vectors into groups such that an absolute value of a difference between any two motion vectors in the same group is less than a predetermined value; and

(c) estimating a motion vector of the first block to be approximately equal to an average of motion vectors belonging to one, having the largest number of motion vectors, of the classified groups.

12. The apparatus according to claim 11, wherein the program further comprises the step of: when there is no determined motion vector to be picked up at the step (a), regarding the motion vectors estimated at the step (c) as determined motion vectors, and then performing the steps (a) to (c).

13. A method of tracking moving objects in time-series pictures with processing the pictures, each picture being divided into blocks, each block consisting of a plurality of pixels, wherein in a case where an identification code of

moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the method comprising the steps of:

(a) estimating a motion vector from a block-size region in a picture at a time t1 to a region of interest in a picture at a time t2 as MV, and estimating an identification code of the block of interest as ID;

(b) determining a correlation-related amount including an absolute value of a difference between the estimated motion vector MV of the block of interest and a motion vector of at least one, having an identification code equal to ID, of blocks surrounding the block of interest in the picture at the time t2; and

(c) determining a value of an estimation function including the correlation-related amount for each first region moved within a predetermined range, and determining the motion vector MV and the identification code on the basis of an approximately-optimum value of the estimation function.

14. The method according to claim 13, wherein the correlation-related amount of the step (c) is expressed by $\Sigma|MV - MV_{neighbor}|/L$, where $MV_{neighbor}$ denotes a motion vector of a block having the same identification code as the identification code ID of the block of interest, within

blocks surrounding the block of interest, Σ denotes a sum over the blocks having said same identification code ID, and L denotes a number of the blocks having said same identification code ID.

15. An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program; and

a processor coupled to the storage device,

wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of pixels, in a case where an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the program comprising the step of:

(a) estimating a motion vector from a block-size region in a picture at a time t1 to a region of interest in a picture at a time t2 as MV, and estimating an identification code of the block of interest as ID;

(b) determining a correlation-related amount including an absolute value of a difference between the estimated motion vector MV of the block of interest and a motion

vector of at least one, having an identification code equal to ID, of blocks surrounding the block of interest in the picture at the time t2; and

(c) determining a value of an estimation function including the correlation-related amount for each first region moved within a predetermined range, and determining the motion vector MV and the identification code on the basis of an approximately-optimum value of the estimation function.

16. The apparatus according to claim 15, wherein the correlation-related amount of the step (c) is expressed by $\Sigma|MV - MV_{neighbor}|/L$, where $MV_{neighbor}$ denotes a motion vector of a block having the same identification code as the identification code ID of the block of interest, within blocks surrounding the block of interest, Σ denotes a sum over the blocks having said same identification code ID, and L denotes a number of the blocks having said same identification code ID.

17. A method of tracking moving objects in time-series pictures with processing the pictures, each picture being divided into blocks, each block consisting of a plurality of pixels, wherein in a case where an identification code of moving object is assigned in a unit of block, and a motion

vector of moving object is determined in a unit of block, the method comprising the steps of:

estimating a motion vector from a block-size region in a picture at a time t1 to a region of interest in a picture at a time t2 as MV, and determining a similarity-related amount between an image of a first region, which is concentric with the block-size region and is larger than the block-size region, and an image of a second region, which is concentric with the block of interest and is in the same form as the first region; and

determining a value of an estimation function including the similarity-related amount for each first region moved within a predetermined range, and determining the motion vector MV on the basis of an approximately optimum value of the estimation function.

18. An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program; and

a processor coupled to the storage device,

wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of

pixels, an identification code of moving object is assigned in a unit of block, and a motion vector of moving object is determined in a unit of block, the program comprising the step of:

estimating a motion vector from a block-size region in a picture at a time t1 to a region of interest in a picture at a time t2 as MV, and determining a similarity-related amount between an image of a first region, which is concentric with the block-size region and is larger than the block-size region, and an image of a second region, which is concentric with the block of interest and is in the same form as the first region; and

determining a value of an estimation function including the similarity-related amount for each first region moved within a predetermined range, and determining the motion vector MV on the basis of an approximately optimum value of the estimation function.

19. A method of tracking moving objects in time-series pictures with processing the pictures, the method comprising the steps of:

(a) dividing each picture into blocks, each block consisting of a plurality of pixels; and

(b) with regarding a background image as a moving object, assigning an identification code of moving object in

a unit of block and determining a motion vector of the moving object in a unit of block.

20. The method according to claim 19, wherein the step (b) comprises the steps of:

(b1) determining motion vectors of respective blocks in a picture at a time t2 through the use of block matching between a picture at a time t1 and the picture at the time t2, without discriminating between the background image and moving objects;

(b2) determining motion vectors of blocks, which are not determined at the step (b1), by estimating the motion vectors through the use of the method according to any one of claims 9, 13 or 14; and

(b3) assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value.

21. An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program; and

a processor coupled to the storage device,

wherein the program make the processor read and

process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is divided into blocks, each block consisting of a plurality of pixels, the program comprising the step of:

(b1) determining motion vectors of respective blocks in a picture at a time t2 through the use of block matching between a picture at a time t1 and the picture at the time t2, without discriminating between the background image and moving objects;

(b2) determining motion vectors of blocks, which are not determined at the step (b1), by estimating the motion vectors through the use of the method according to any one of claims 9, 13 or 14; and

(b3) assigning the same identification code to adjacent blocks if an absolute value of a difference between motion vectors of the adjacent blocks is less than a predetermined value.

22. A method of tracking a moving object in time-series pictures with processing the pictures, each picture being divided into blocks, each block consisting of a plurality of pixels,

wherein a plurality of object maps of different times have been stored, each object map having motion vectors of the moving object in a unit of block, the method comprising

the steps of:

(a) determining a motion vector of a region of interest for one of the plurality of object maps; and

(b) determining a motion vector of a region, to which the region of interest is moved with using the determined motion vector in positive or negative direction thereof, on the basis of an object map at a time corresponding to completion of the movement of the region,

wherein the moved region is set as a region of interest on the object map of the time corresponding to the completion of the movement of the region, and the step (b) is repeated a plurality of times to track the region of interest.

23. The method according to claim 22, wherein at the step (a) or the step (b), a weighted motion vector average is determined as a motion vector of the region of interest with using motion vectors of blocks overlapping with the region of interest, where weights given to the respective motion vectors correspond to the number of pixels of respective portions overlapping between the respective blocks and the region of interest.

24. The method according to any one of claim 22 or 23, wherein the region of interest of the step (a) corresponds

to one block.

25. The method according to any one of claim 22 or 23, wherein the object map of the step (a) is a new object map, and at the step (b), the region of interest is moved in the negative direction of the motion vector.

26. The method according to any one of claim 22 or 23, wherein the number of the plurality of object maps is kept constant by updating an oldest object map with a newest object map.

27. The method according to any one of claim 22 or 23, wherein, on the basis of both a region of interest at a time t1 and a corresponding region of interest at a time t2, a motion vector from the time t1 to the time t2 is determined as a fast-forward motion vector, and

wherein if a difference of an absolute value between respective fast-forward motion vectors of two adjacent regions of interest on the object map of the time t2 is more than a predetermined value, the two adjacent regions of interest are recognized as different moving objects.

28. The method according to claim 27, wherein, if a plurality of peaks are present in a histogram of absolute

values of motion vectors for a single cluster including adjacent blocks having motion vectors, an interval between the times t1 and t2 is determined on the basis of a speed difference between the peaks.

29. The method according to claim 27, wherein each time the interval between the times t1 and t2 is increased, it is determined whether or not the absolute value of the difference between the respective fast-forward motion vectors of the two adjacent regions of interest on the object map of the time t2 is more than the predetermined value, and

wherein if the interval is less than a predetermined maximum value and if the absolute difference is more than the predetermined value, then the two adjacent regions of interest are recognized as different moving objects.

30. An apparatus for tracking moving objects in time-series pictures, comprising:

a storage device for storing the time-series pictures and a program; and

a processor coupled to the storage device,

wherein the program make the processor read and process the time-series pictures to track the moving objects in the pictures, and by the processing, each picture is

divided into blocks, each block consisting of a plurality of pixels, a plurality of object maps of different times have been stored, each object map having motion vectors of the moving object in a unit of block, the program comprising the step of:

(a) determining a motion vector of a region of interest for one of the plurality of object maps; and

(b) determining a motion vector of a region, to which the region of interest is moved with using the determined motion vector in positive or negative direction thereof, on the basis of an object map at a time corresponding to completion of the movement of the region,

wherein the moved region is set as a region of interest on the object map of the time corresponding to the completion of the movement of the region, and the step (b) is repeated a plurality of times to track the region of interest.

31. The apparatus according to claim 30, wherein at the step (a) or the step (b), a weighted motion vector average is determined as a motion vector of the region of interest with using motion vectors of blocks overlapping with the region of interest, where weights given to the respective motion vectors correspond to the number of pixels of respective portions overlapping between the respective

blocks and the region of interest.

32. The apparatus according to any one of claim 30 or 31, wherein the region of interest of the step (a) corresponds to one block.

33. The apparatus according to any one of claim 30 or 31, wherein the object map of the step (a) is a new object map, and at the step (b), the region of interest is moved in the negative direction of the motion vector.

34. The apparatus according to any one of claim 30 or 31, wherein the program further comprises the step of:

keeping the number of the plurality of object maps constant by updating an oldest object map with a newest object map.

35. The apparatus according to any one of claim 30 or 31, wherein the program further comprises the step of:

on the basis of both a region of interest at a time t1 and a corresponding region of interest at a time t2, determining a motion vector from the time t1 to the time t2 as a fast-forward motion vector; and

if a difference of an absolute value between respective fast-forward motion vectors of two adjacent

regions of interest on the object map of the time t2 is more than a predetermined value, recognizing the two adjacent regions of interest as different moving objects.

36. The apparatus according to claim 35, wherein the program further comprises the step of:

if a plurality of peaks are present in a histogram of absolute values of motion vectors for a single cluster including adjacent blocks having motion vectors, determining an interval between the times t1 and t2 on the basis of a speed difference between the peaks.

37. The apparatus according to claim 35, wherein the program further comprises the step of:

each time the interval between the times t1 and t2 is increased, determining whether or not the absolute value of the difference between the respective fast-forward motion vectors of the two adjacent regions of interest on the object map of the time t2 is more than the predetermined value; and

if the interval is less than a predetermined maximum value and if the absolute difference is more than the predetermined value, recognizing the two adjacent regions of interest as different moving objects.